



## Proton Study Group Status and Plans

Director's Review  
August 2005

Mike Syphers



## Future Possible Proton Upgrades

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- Study Group has been formed to investigate steps after Proton Plan
  - Consider modest-cost upgrades to existing facilities to enhance neutrino program
- Assumptions:
  - p Plan delivers as expected by 2008
  - A Proton Driver Linac becomes operational no earlier than 2015
  - Run II finishes in 2009; complex can be mostly devoted to neutrino program



- **Draft Charge to Proton Plan II Study Group**

An extended neutrino program is expected to be a core ingredient of the Fermilab program through the first half of the next decade. Elements of this program will likely include an extension of the present Minos experiment and the Nova off-axis experiment, both using the NuMI beamline.

The beam delivered to NuMI will be increased over the next few years through upgrades under the present Proton Plan which is expected to complete in 2008. The main elements of this plan target reduction in Booster losses (and thus higher proton throughput in the Booster), a reduction in losses in the MI, the development of slip-stacking or barrier-bucket stacking in the MI, and an upgrade in the MI RF system. The goal for NuMI with these upgrades is a rate in excess of  $5E13$  PoT every 2.2 seconds.

The study group should focus on the period beyond the present Proton Plan. You should assume that the Tevatron program terminates in 2009, and that the Proton Driver starts operation in 2015 or later. The group should study viable concepts for upgrading and refocusing the complex to maximize delivery to the NuMI beamline from 2009 on.



## Study Group

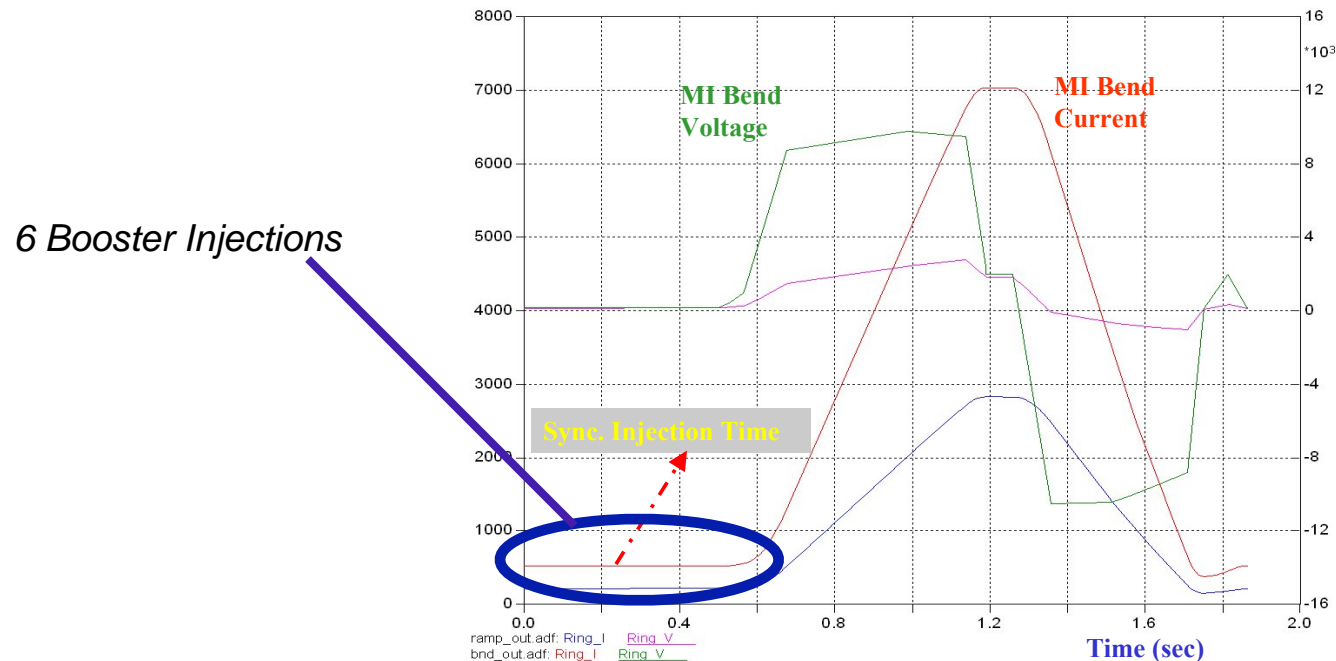
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- **Members:**
  - M. Syphers (chair), P. Derwent, E. Prebys, S. Nagaitsev, R. Pasquinelli
- **Schedule**
  - Had been meeting 1-2x/week, starting in early April, through ~mid-May; essentially on hold since then
- **Discussion topics, so far:**
  - Use of Recycler Ring as proton accumulator
  - Alternative Proton Source (McGinnis)
  - Past Proton Driver studies
  - Main Injector upgrade requirements
  - FNAL Operational costs
  - Neutrino program overview



## First Option -- Recycler

- First foreseen option would be to use Recycler Ring as proton accumulator during Main Injector ramp
  - Main Injector fill time could be reduced from ~0.7 sec to ~10 msec. Cycle time thus reduced from ~2.2 to ~1.5 sec
    - thus, ~50% increase in protons/sec to target



Courtesy I. Kourbanis



## Recycler Option

- Appears to need only minor modifications to existing facility
  - Short beam line connecting MI-8 line to RR
  - Probable upgrades to RR rf system
- Questions:
  - Can RR handle higher intensity? Presently,  $\sim 2-3 \times 10^{12}$ ; needs  $\sim \times 20$  more for neutrino program
    - beam cleaning, stacking studies --  $\sim 1.5 \times 10^{13}$  p's used
  - What would be stacking procedure?
    - 53 MHz transfer? Barrier Bucket stacking? ...
  - Beam studies and calculations will be suggested to help answer ...



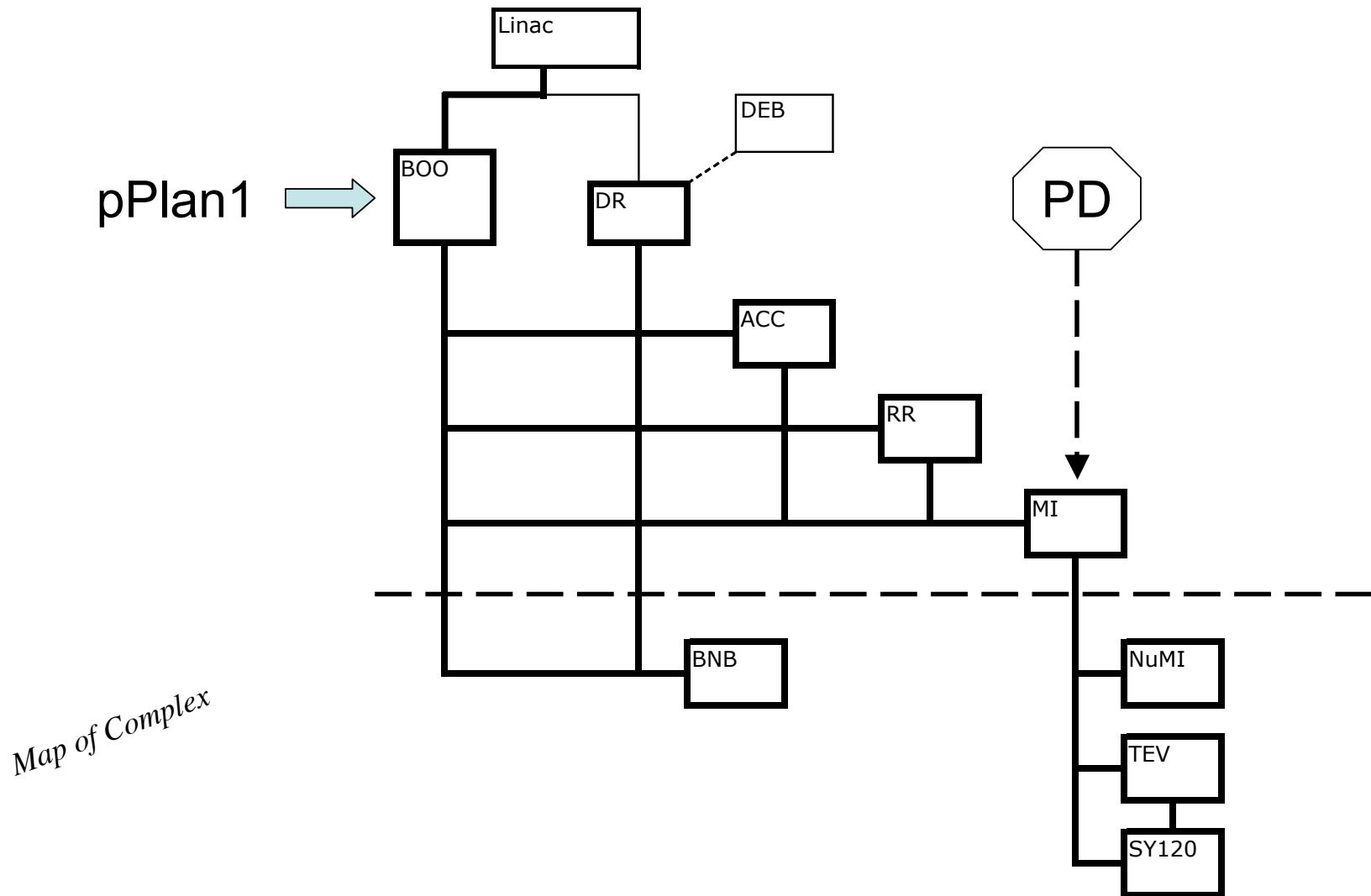
## Other Possibilities?

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- Study Group will attempt to address other alternatives; occasionally receiving suggestions
- What ever options are considered, must allow for a "staged approach"
  - incurred downtime to implement an upgrade option must be minimal
  - upgrade path can be halted at any stage

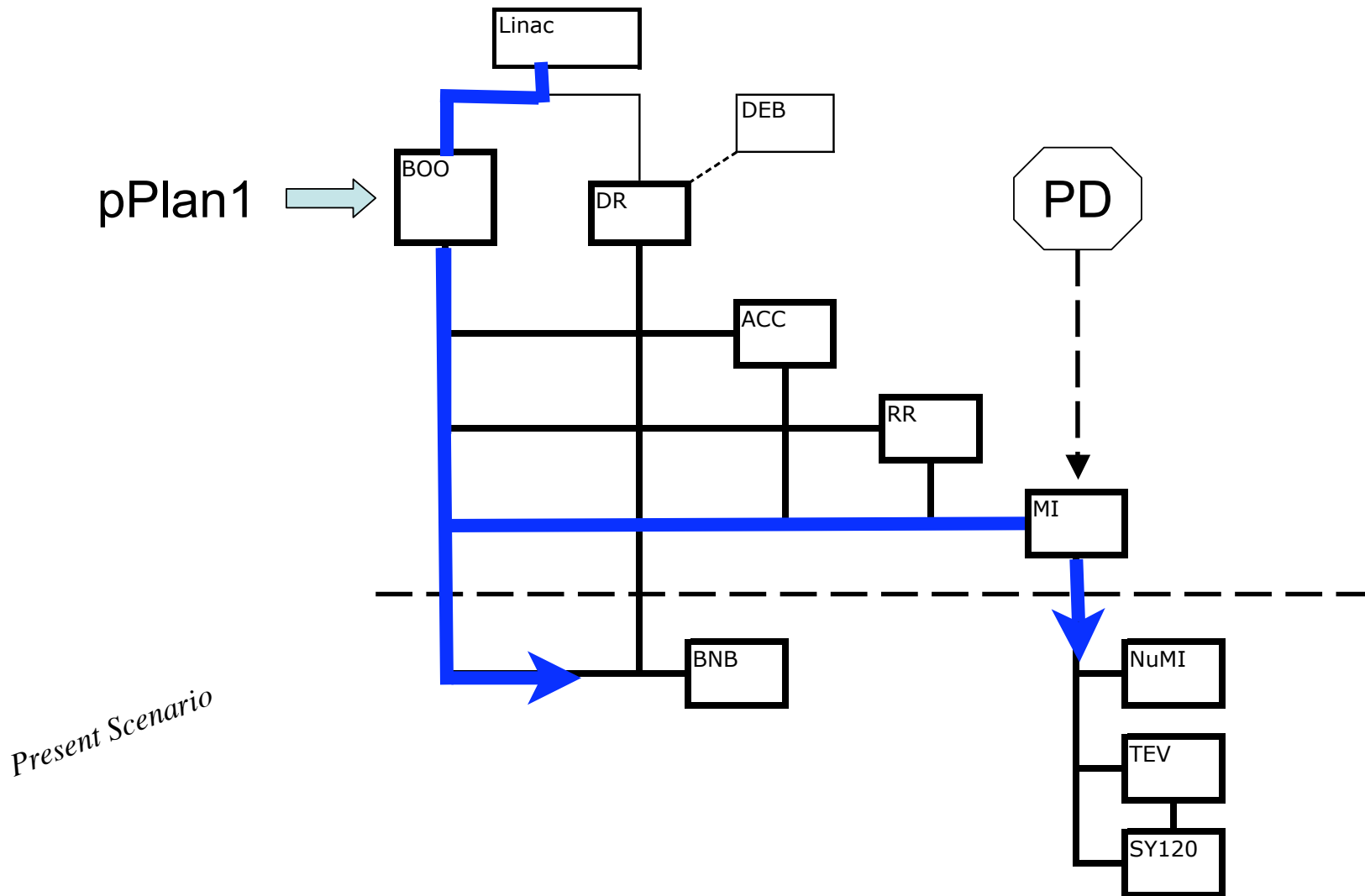


# Possible Road Map for Use/Study...



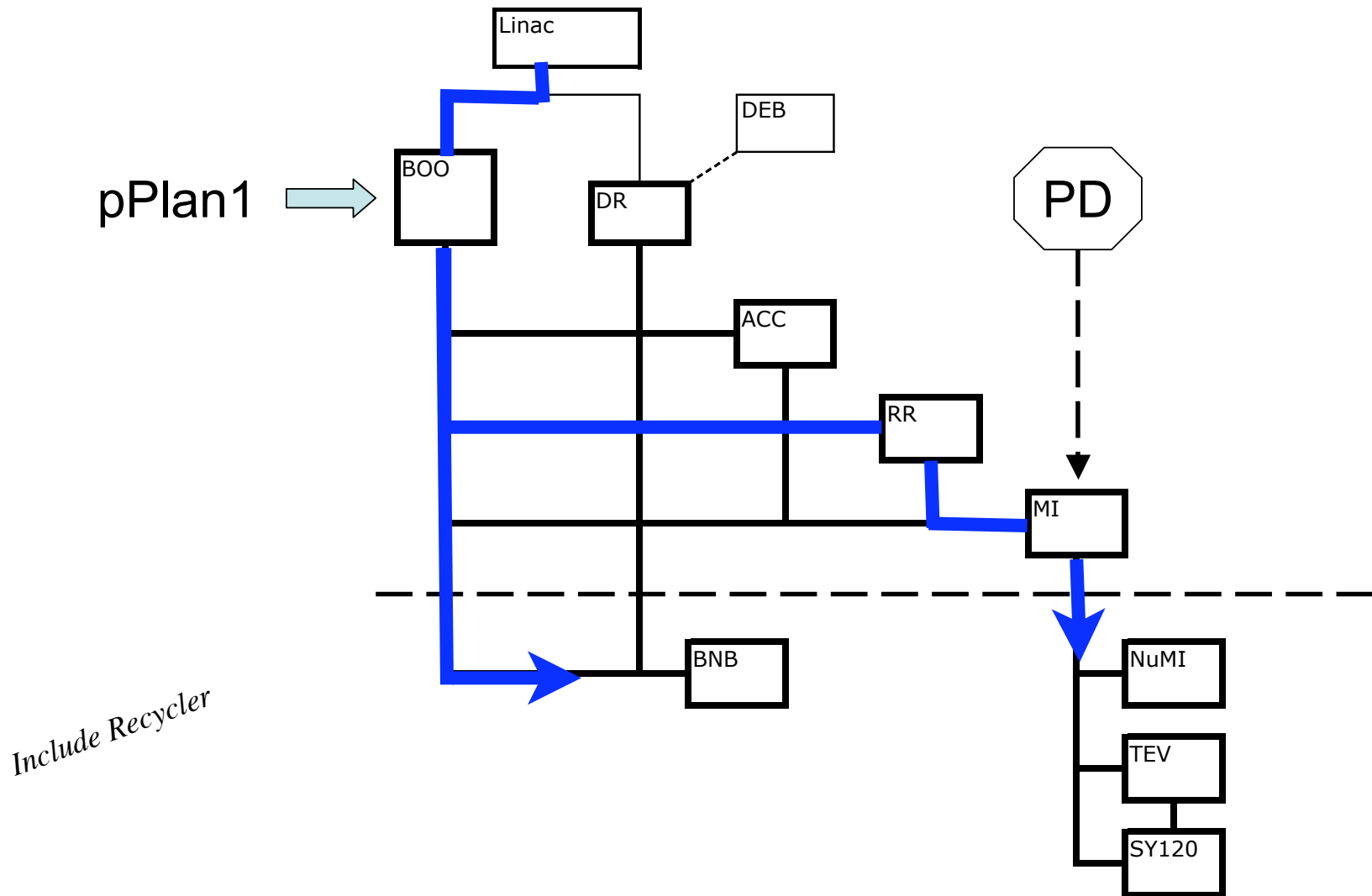


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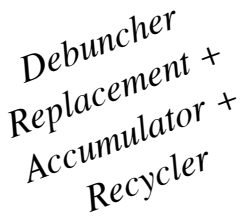




# Possible Road Map for Use/Study...



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## Present Status

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- Has been 'on hold' past ~1-2 months due to
  - Electron Cooling commissioning, Proton Plan (this!) Reviews, pbar Rapid Response effort, summers vacations, Linear Collider organization, Snowmass, etc.
- Negotiated plan w/ AD Head:
  - Originally wanted report in June...
  - ... will issue a report in Fall concerning RR issues
  - re-evaluate, at that point, re-direct from there
- Group will continue to meet; likely to expand and look into further details of most likely scenarios
  - hope by September 1, in full(er) swing again...
  - looking for first report ~October